A high resolution germanium detector array for hypernuclear studies at $\bar{\text{P}}$ANDA

S. Bleser[1], J. Gerl[3], F. Iazzi[4], I. Kojouharov[3], J. Kojouharova[3], J. Pochodzalla[2], K. Ritten[2], C. Sahin[2], A. Sanchez Lorente[1], ●M. Steinen[1]

[1]Helmholtz-Institut Mainz, Germany; [2]Institut für Kernphysik, Mainz,Germany; [3]GSI, Darmstadt, Germany; [4]Politecnico di Torino and INFN, Sez. di Torino, Italy

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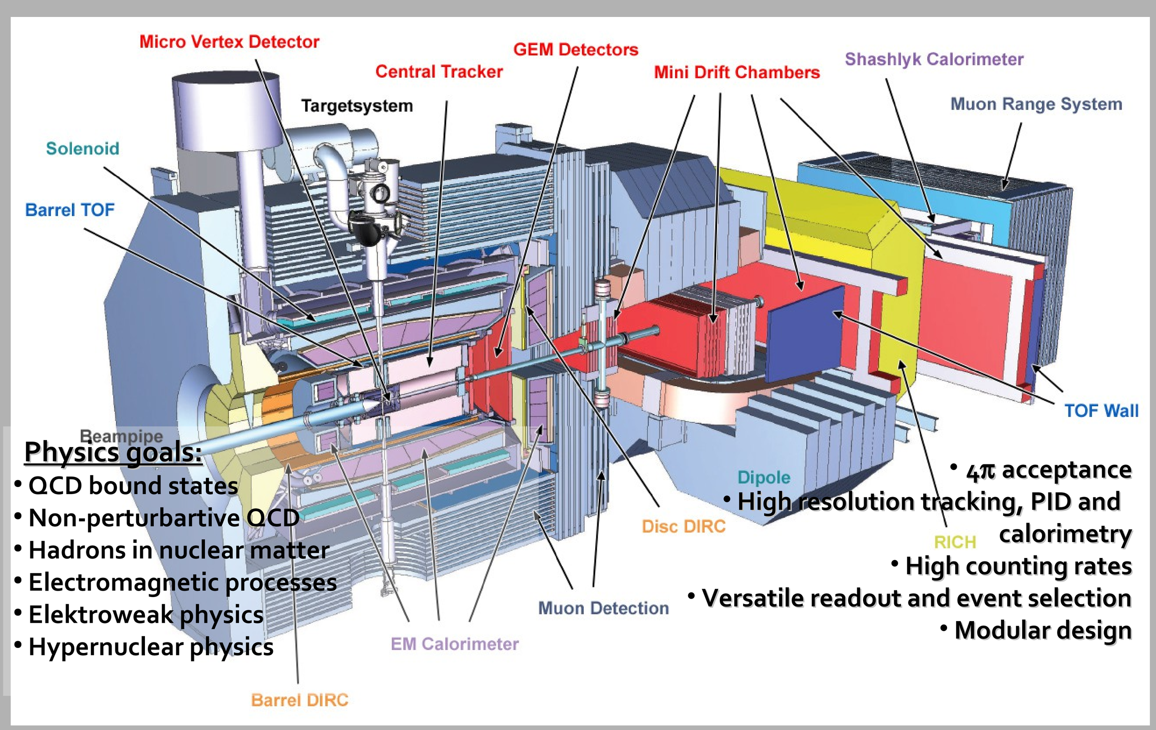
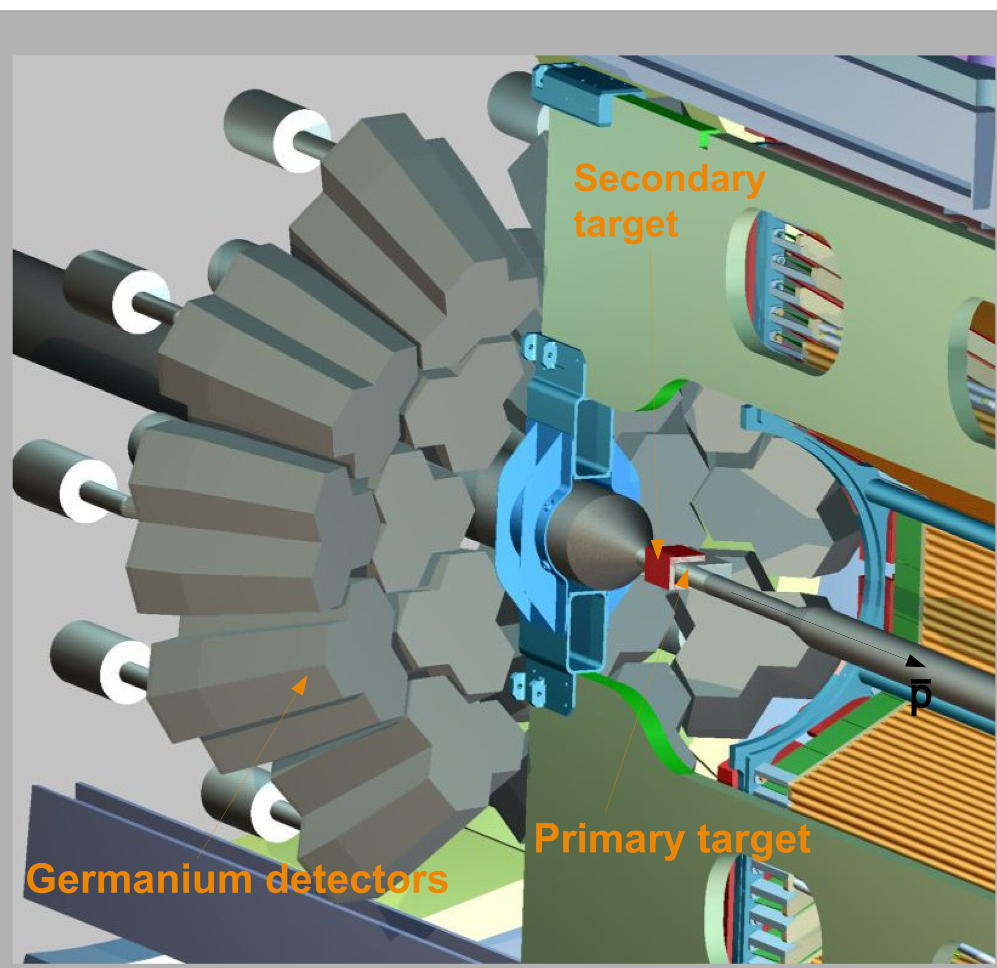
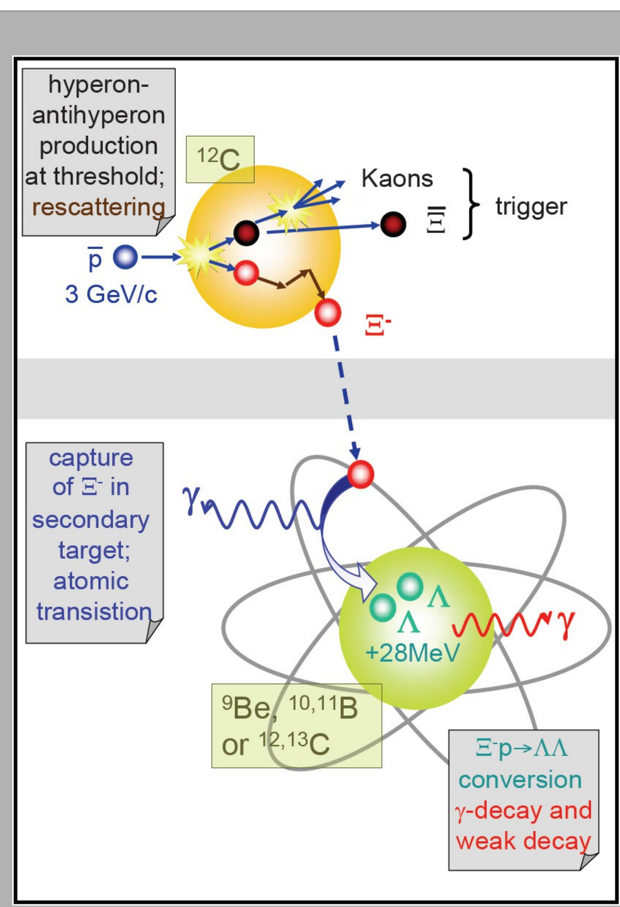


The $\bar{\text{P}}$ANDA spectrometer in standard configuration

For target system see Poster HK 53.5

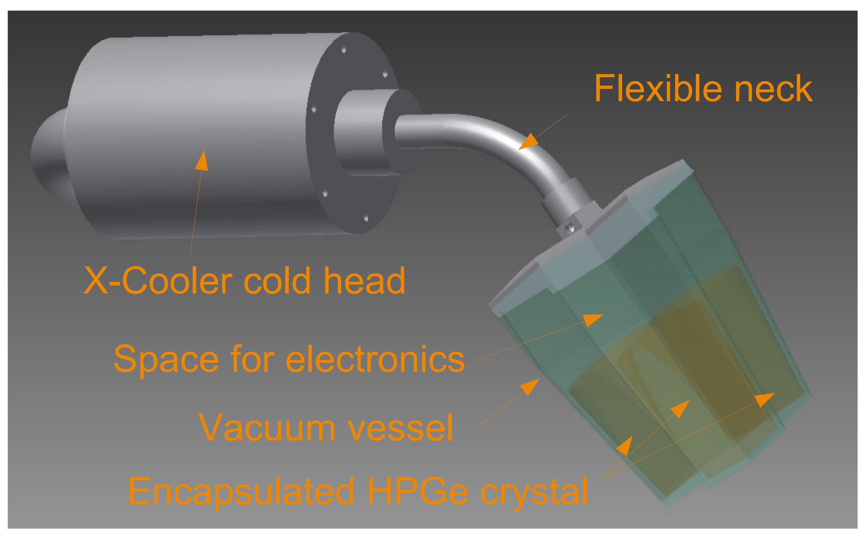


Integration of specific detectors inside the $\bar{\text{P}}$ANDA barrel spectrometer to study Double-Λ-Hypernuclei

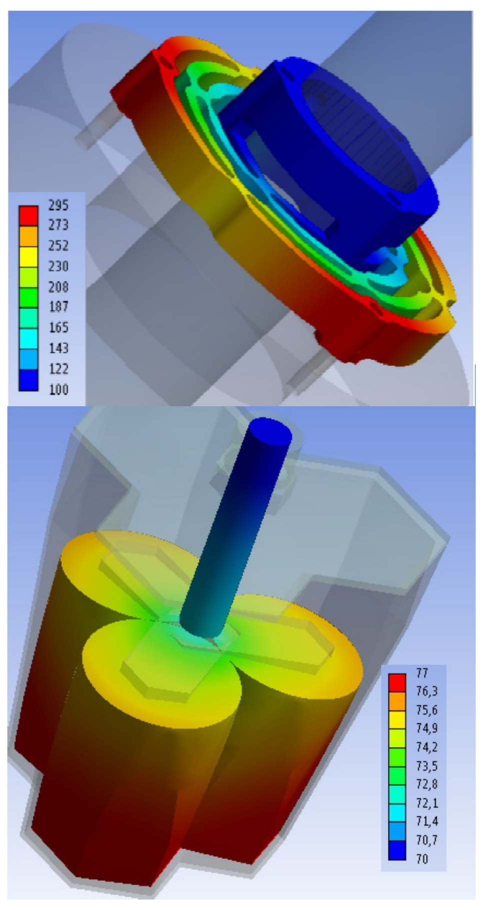


Production process of Double-Λ-Hypernuclei at $\bar{\text{P}}$ANDA

Design of the triple cluster detectors

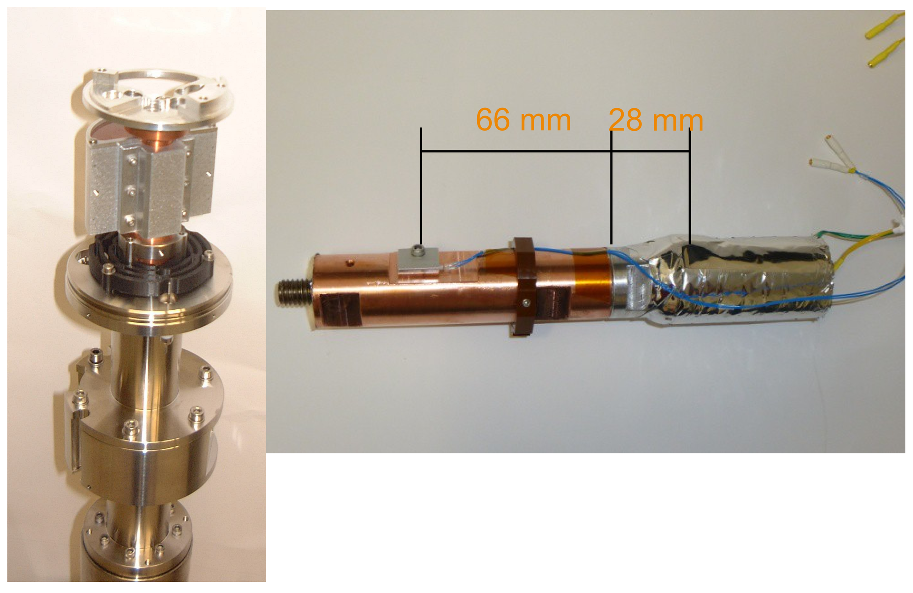


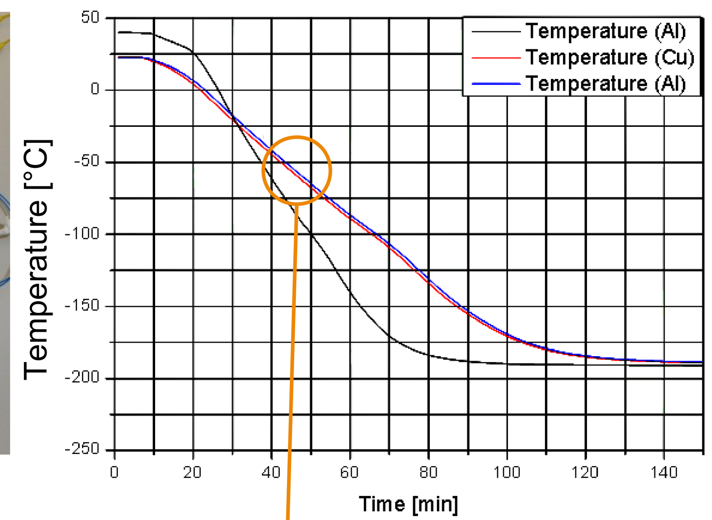
Design of a detector with three crystals

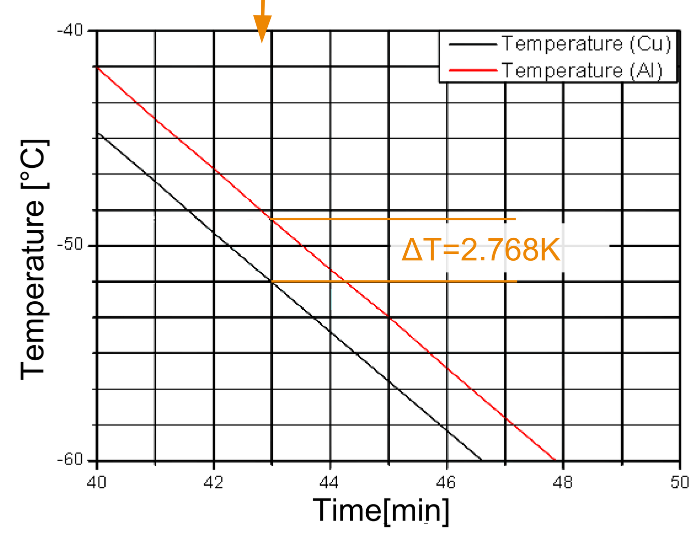


Simulation of the thermal capabilities of the planned design

Test of the electro-mechanical cooling system

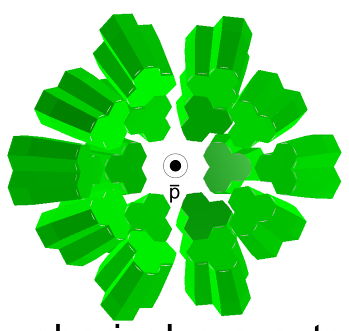




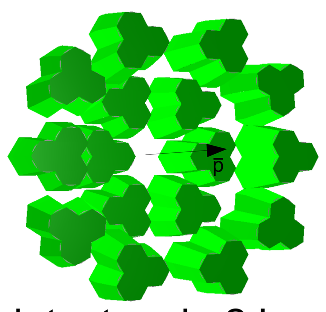


The limitation of space inside the $\bar{\text{P}}$ANDA barrel spectrometer makes a standard LN_2 cooling unfeasible. An electro-mechanical cooler (Ortec X-Cooler II) can be placed outside of the spectrometer. A measurement of its cooling power yields 13 W. This cooling power is reduced by the thermal contact resistance of the individual cold finger parts leading to the crystal. This resistance must be reduced in the future.

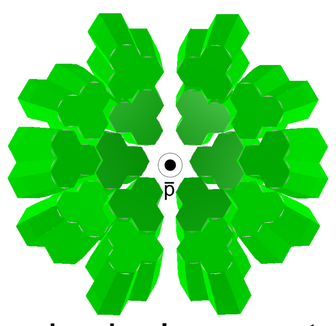
Simulation of the detector array



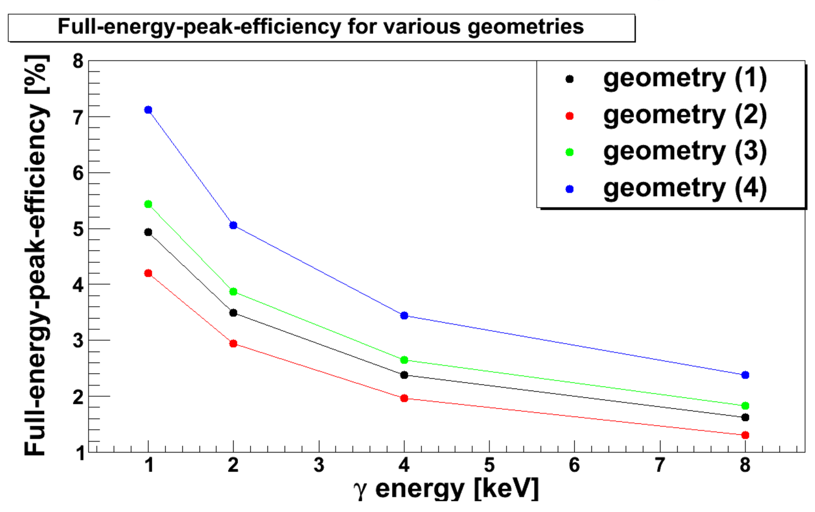
spherical geometry (1)
r = 30 cm



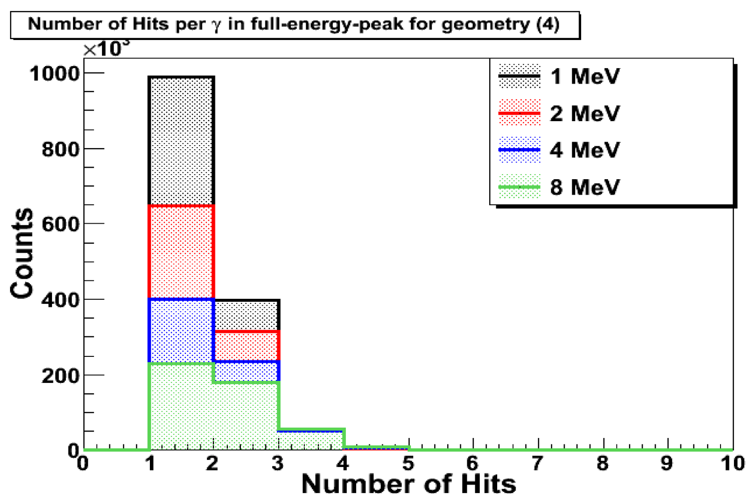
detectors in 2 layers (2)



spherical geometry r = 40 cm,
+10 cm offset in beam direction (3)
+20 cm offset in beam direction (4)



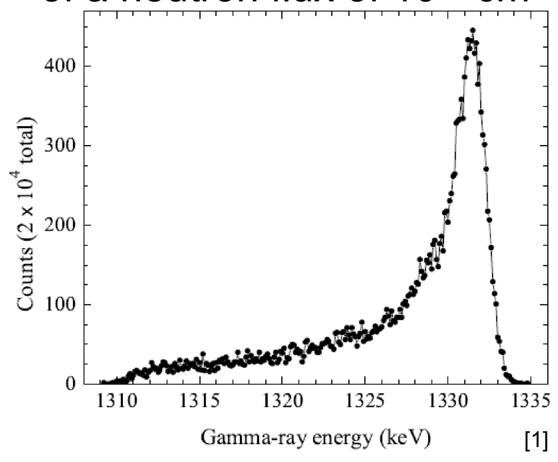
The efficiency of various geometries is compared by simulation of γ in the expected energy range of 1 to 8 MeV. The plot below shows that the detection efficiency strongly depends on the detector multiplicity.

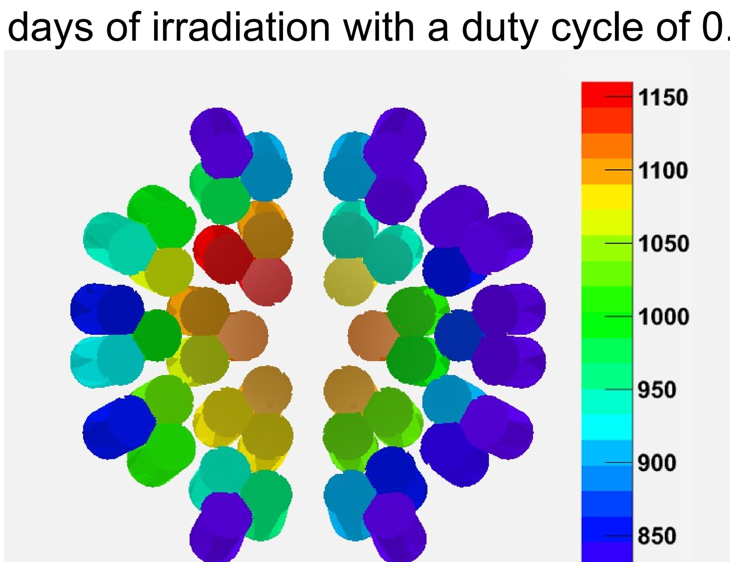


Neutron background studies

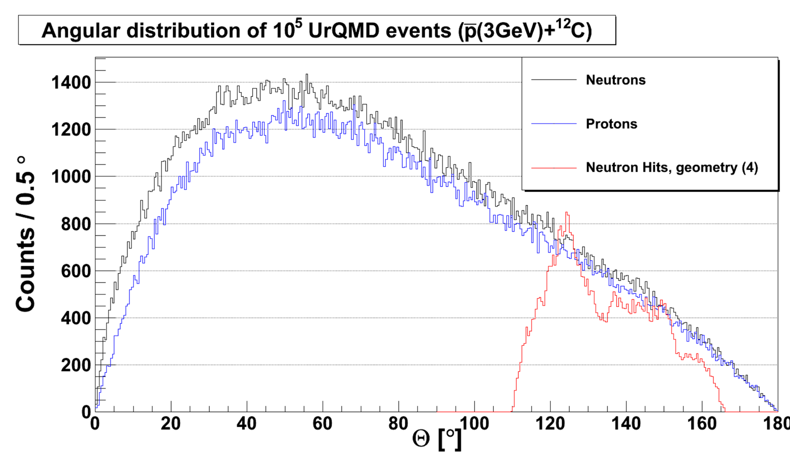
The germanium crystals will suffer a high background of thermal neutrons inside the $\bar{\text{P}}$ANDA spectrometer. This background is simulated using UrQMD generated events. The maximum neutron load per crystal for geometry (4) is 12 kHz. At the expected reaction rate of $2 \cdot 10^6$ Hz this results in $3.4 \cdot 10^9$ n/cm² after 100 days of irradiation with a duty cycle of 0.5.

Simulated lineshape after irradiation of a neutron flux of 10^{10} cm^{-2}





Neutron hits per crystal
(10^5 UrQMD events, p̄(3GeV)+^{12}C)



[1] Van Sicilen, C.D.; et.al , Nuclear Science, IEEE Transactions on , vol.59, no.5, pp.2487-2493, Oct. 2012

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